

base of the instrument, the axis will be correctly adjusted in azimuth.

Irregularities in the Clock.—In what precedes I have supposed that the clock was running correctly to sidereal time.

In this connection there are two cases to be considered. If the clock is one of Sir Howard Grubb's latest pattern, in which the rate is electrically controlled by a sidereal pendulum clock, this condition will be fulfilled.

If, however, the clock is one whose rate may be depended upon to remain constant during the exposure, but without control from a pendulum clock, it may be rated to keep sidereal time by observation of a star at the equator. For the first of equations (3) shows that $d(\theta - t)$ is zero for such a star. Hence, in order to rate the clock correctly, it is only necessary to direct the telescope to a star on the equator and to adjust its rate until it keeps pace with the star.

But if the rate cannot be depended on to remain constant during the interval between the exposures, since the principle of the method will not allow of any hand correction being introduced, it will be necessary to reject the displacement in R.A. and to depend entirely on that in declination. We can, however, by properly selecting the stars, obtain both k and A from these displacements. For if in the first instance we take a star on the meridian, since θ is then equal to zero, we find from equation (5) that

$$A = -\frac{YR}{15 dt} \sec \phi ;$$

and if we next take a star at a distance of 6^h from the meridian, we have

$$k = \frac{YR}{15 dt}.$$

The Observatory, Dunsink, Co. Dublin :
1893 December 1.

Note on a Star-correction Facilitator, or an instrument for readily obtaining the products of pairs of numbers, one number being taken from one set (e.g. day-constants) and the second from another set (e.g. star-constants). By T. C. Hudson, B.A. (Cantab.)

(Communicated by A. M. W. Downing.)

This instrument, which may for the present be briefly described as an antilog.-roller with a set of four shiftable windowed sheaths, was primarily devised for the sake of minimising the labour involved in the calculation of star ephemerides. The principle may be explained as follows :—

I. If the first 100 natural numbers be written at regular intervals, thus,

0	10	.	.	.	.	90
1	11	.	.	.	.	91
2	12	.	.	.	.	92
.
.
.
.
9	19	.	.	.	.	99,

and if a pair of compasses be stretched from one number to another, and bodily moved about on the paper, up or down, right or left, but without altering the direction of the join of the points, then the *difference* of the numbers under the points will evidently remain the same whatever the numbers may be.

II. If these 100 natural numbers be replaced by the antilogarithms of '00, '01, '02, . . . '99, then the *ratio* of the quantities under the compasses will remain constant. This is evident from the fact that if the difference of two quantities be constant, so also is the ratio of their antilogarithms.

These considerations led to the construction of the instrument, which may be thus described.

On a cylinder are printed, or otherwise exhibited, at regular intervals, 100 columns of numbers, viz. the four-figure antilogs. of

'0000	'0100	&c.	'9900
'0001	'0101	&c.	'9901
'0002	'0102	&c.	'9902
.	.	.	.
.	.	.	.
.	.	.	.
'0099	'0199	&c.	'9999
'0100	'0200	&c.	'0000
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
'0199	'0299	&c.	'0099
'0200	'0300	&c.	'0100

the last column having, of course, the first for its right-hand neighbour. Thus the cylinder practically furnishes a complete antilog. table, rolled end to end, and combined with a similar

H 2

table placed beneath it and rotated one space to the left. The arguments '00, '01, . . . '99 are written above the top row, and '02, '03, . . . '99, '00, '01 below the bottom row. The vertical arguments may conveniently be written on a slip of card and applied to the cylinder when necessary.

On this cylinder is fitted a cylindrical sheath, capable of sliding up and down and of slipping round the cylinder. The length of the sheath is only 100 spaces, that is, half the length of the cylinder. This sheath is moved up to the top of the cylinder, so as to cover the upper half, and a zero mark is made over the antilog. of '0000. Then thirty-eight windows are cut in the sheath so as to disclose the thirty-eight day-numbers called *A*, or, more precisely, so as to disclose the thirty-eight antilogarithms of the logarithmic day-constants known as $\log A$. Finally, arrows are drawn from window to window showing the order of succession. Three other sheaths are made in like manner for the sets *B*, *C*, and *D*.

In order, then, to obtain the thirty-eight quantities called *cC* for a star whose $\log c$ is, say, 9.2764, we have merely to shift the "*C*" sheath till its zero mark is in column 27 and row 64, whereupon the thirty-eight windows immediately disclose the thirty-eight required quantities *cC* ready to be transcribed without either addition, interpolation, or the eye-wearying process of selecting the right number from the rows and columns of a large table. The number strikes the eye, without requiring to be selected from its neighbours.

The *decimal significance* of the antilogarithms is, of course, not given by the cylinder, just as an ordinary antilogarithm table does not furnish us with the position of the decimal point. But the value of the first quantity may be easily ascertained, and then the decimal significance of the rest of the numbers may be determined by keeping an eye on the differences, and by the consideration that the ratio of any two *cC*'s is the same for all stars.

Photograph of the Nebula H I 168 Ursæ Majoris.

By Isaac Roberts, D.Sc., F.R.S.

The nebula is in R.A. $10^h 12^m$, Decl., $41^\circ 57'$ north, and the photograph was taken on 1893 April 14, with an exposure of the plate during 4 hours. The scale of the enlarged photograph now presented is 1 millimetre to 24 seconds of arc.

The nebula is No. 3,184 in the *New General Catalogue*, and 2,052-2,053 in the *General Catalogue*.

Sir J. Herschel, in the *General Catalogue*, p. 83, describes 2,052 as pretty bright, very large, round, very gradually brighter